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A NEW SPECIES OF EMBIOPTERA FROM  
THE GALÁPAGOS ISLANDS

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Insects of the order Embioptera disperse slowly even on continental land masses owing to the universal apterism of females and their almost complete confinement to silk galleries. It had been believed that the order is absent on oceanic islands except for a few species transported by man. Therefore, the recent discovery by David Cavagnaro of a native species on the Galápagos Islands was quite unexpected.

This interesting new species is small, apterous in both sexes, and a member of the New World family Anisembiidae. It and several other new species comprise a distinct section of the widespread genus *Chelicerca* Ross. This species-group is confined to western Ecuador and Peru, chiefly in coastal thorn-bush zones. A Peruvian species occurs in lichen growth of fog-dampened loma zones at least as far south as the Chilean border.

Males of all mainland species of this group are alate and very distinct in appearance from those of the Galápagos species. A close relationship is indicated, however, by similarities in the male terminalia. The more conspicuous differences, such as the male's apterism, robust form, and circular head with small eyes, are juvenile characters attributable to neoteny, a condition most likely to develop in a small gene pool and to be selected for in marginal environments, such as arid regions. Apterism of males has appeared independently on almost all evolutionary lines of the order.

After first considering rafting and aerial transport, the writer has concluded that ancestors of the Galápagos embiid most likely were carried to the islands and distributed therein by birds. The habits of the Galápagos species make it ideally suited for such transport, its niche being curled lichens and crevices in rocks or bark. When birds roost or nest on or near such surfaces

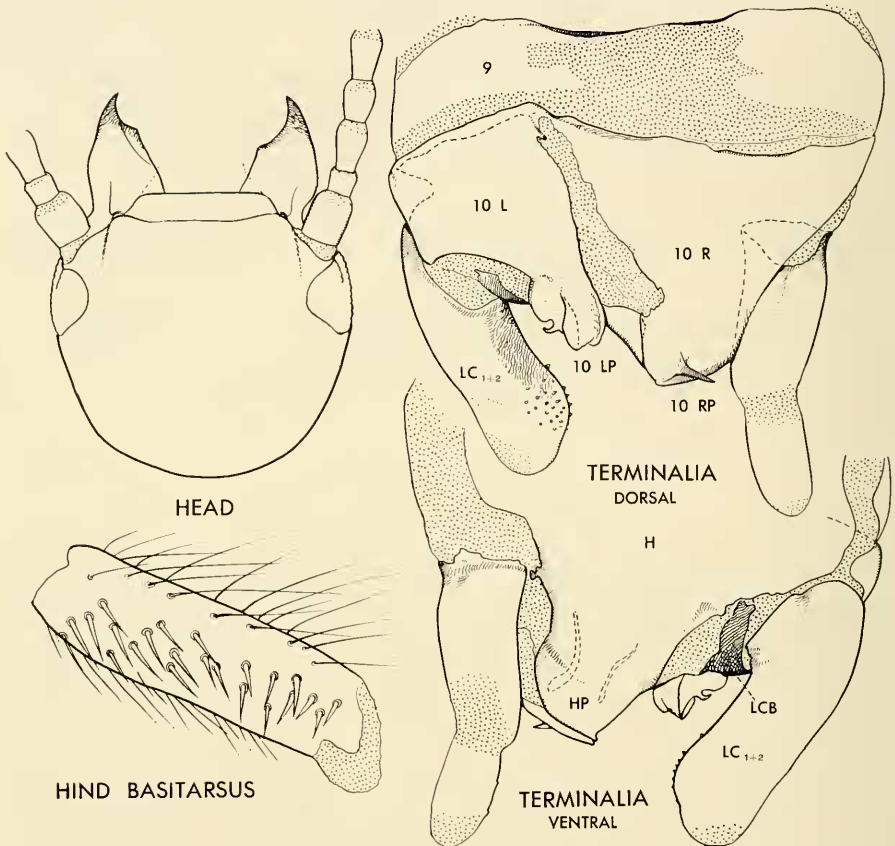


FIGURE 1. Important characters of head and terminalia of the holotype of *Chelicerca galapagensis* Ross, new species. Explanation of symbols: 10L and 10R = left and right hemitergites of tenth abdominal segment; 10LP and 10RP = process of 10L and 10R. H = hypandrium (9th sternite); HP = process of H. LCB = left cercus-basipodite. LC<sub>1+2</sub> = combined segments of left cercus. Setae usually omitted, stippling represents membrane.

it should be easy for embiids to crawl or extend their silk galleries, between the inviting body feathers of birds. Once in such retreats, the embiids could remain for considerable time because of the security of well attached silk galleries which would reduce dislodgement even during flight. On Wenman Island embiid colonies were found within the nesting areas of boobies and other sea birds. On Duncan Island Cavagnaro even found embiid galleries ramifying an abandoned finch nest.

Embiids were collected on three islands but no tendency toward subspeciation was noted. This may be due to frequent interisland movement of the breeding stock by birds. Although only one species was found, future collectors

should be alert to the possibility that other groups of the order may have become established, such as one or more species of the family Teratembidae which is well represented on the adjacent Santa Elena peninsula. The tropicopolitan weed species, *Oligotoma saundersii* (Westwood), is common on trunks of shade trees in Guayaquil and eventually may be introduced into the islands.

I wish to acknowledge the excellent field work of David Cavagnaro who discovered the species and provided the habitat notes used in this paper. The Belvedere Fund, the California Academy of Sciences, and the National Science Foundation are to be thanked for providing support for Cavagnaro's and R. I. Schuster's entomological survey. This paper was prepared during a period of grant support by the National Science Foundation.

***Chelicerca galapagensis* Ross, new species.**

(Figure 1.)

**HOLOTYPE.** Male, on slide deposited in the California Academy of Sciences, San Francisco.

**TYPE DATA.** Galápagos: Duncan Island (Isla Pinzón), 1300 feet elevation, matured in culture 22 April 1964 (D. Q. Cavagnaro).

**DESCRIPTION.** Appearance: small, robust, apterous; medium brown with darker head and terminalia, pale membranous area between pro- and mesothorax forming a cream band. Color details (in alcohol): Cranium brown, mottled, dorsobasal pattern obsolete, ecdysial lines darker; gular surface pale brown, eyes small, blackish; darker than cranium. Antennal segment I chestnut-brown, II paler, III-VII straw-yellow, others to apex blending to chestnut-brown with apical membranes tinged with pink; total segments 14. Sclerotized portions of mouthparts light brown, except apices of palpi which are darker brown. Prothoracic and cervical sclerites, and forelegs, medium brown with darker lines along sutures and other sclerotic areas; comparable areas of mesothorax yellow-brown; those of metathorax similar but tinged and mottled with rust-red; thoracic fat bodies pure white and visible through intersegmental membranes, those between pro- and mesothorax especially conspicuous and creating a pale intersegmental band. Abdomen darker than thorax owing to strong, brick-red, subcutaneous mottling throughout dorsum; ventrally pale in basal half but blending caudad to mottled chestnut-brown. Tenth tergite and processes largely blackish-brown, cleft membrane dark cream-white; ninth sternite dark chestnut-brown, margins of lobe blackish; left paraproct blackish; basal segment of right cercus with its rim and inner margin blackish, otherwise mahogany-brown; basal portion of left cercus blackish-brown, especially ventrally, its apical lobe and apical segment of right cercus light golden-brown. Body length (on slide) 6.0 mm.

Important anatomical features, as figured: cranium exceptionally broad, circular; as broad as long. Eyes very small, as in nymphs; facets coarse.

Antennae unusually short, only 14-segmented; basal segments stout; apicals becoming small. Mandibles short, outer margins broadly rounded; apices acutely pointed, without teeth; left mandible with a broad, obtuse angle on inner-apical arc. Body and legs stout, form comparable to that of nymphs and adult females. Abdominal terminalia small with details of processes, as figured; cerci unusually short and angled mesad, apical segment of right cercus exceptionally small.

ALLOTYPES. Female, in alcohol, with holotype data and disposition.

DESCRIPTION. Appearance: Small, pale golden-tan with thorax whitish and abdomen dark brown. Color details: Cranium basically golden-amber, lightly mottled with rust-red; a darker obtuse line curving caudad across head from eye to eye is due to a gap between the paler brain and muscle tissue visible through integument. Eyes lavender-black. Antennae 16-segmented, segments I and II straw-yellow, other segments medium brown with pale joint membranes, apicals slightly darker than subbasals. Mouthparts yellow-tan, mandibles golden with mahogany inner edges. Sclerites and legs of prothorax yellow-tan; meso- and metathorax paler with transparent integument revealing internal organs, especially the dark crop; thoracic fat bodies white, thus intensifying pallidity of the segments. Mid and hind legs concolorous with forelegs. Abdominal sclerites medium brown, darkened by mottled rust-brown on soft tissue beneath integument; intersegmental membranes, and most of venter of abdomen, pale yellow-tan whitened by flecks of internal fat bodies; eighth sternite uniformly chestnut-brown medially, lateral thirds dark mahogany-brown; ninth sternite paler mahogany, membranes of basal emargination whitish; integument of paraprocts pale, revealing internal tissue; cerci yellow-tan, tinged with rust-red. Important anatomical features: short circular head and the well pigmented, perigenital sclerites. Body length 7.0 mm.

PARATYPES AND PARALLOTYPES. A moderately large series of adults reared from the same culture as the holotype. Deposited in the California Academy of Sciences, United States National Museum, Paris Museum, and the British Museum (N. H.)

VARIATION. The only appreciable variation occurs in the pigmentation of males. Some individuals are paler than others, especially in the head, but this may be because of insufficient hardening of the integument following transformation to the adult stage.

OTHER SPECIMENS EXAMINED. A short series of both sexes collected on Wenman (Wolf) Island on summit cliffs at an elevation of 1300 feet. Adults field-collected January and February, 1964, others reared during April and May, 1964 (D. Q. Cavagnaro). On Santa Cruz (Indefatigable) Island 13 males and one female were collected 16-IV-64 by Cavagnaro on the island's lower east slope at an elevation of 500 feet, below Table Mountain. A very large series of adults also was collected here on 2-VI-64 by S. Horneman and F. Cruz.

All of the above specimens conform closely with the type series and are considered conspecific.

RELATIONSHIPS. Males of *C. galapagensis* are distinct from all known species of *Chelicerca* (all undescribed) from western South America by virtue of male apterism, the circular head with nymph-type small eyes, short antennae with fewer segments, and numerous distinctions of the male terminalia. It is related, however, to several undescribed species of the genus occurring at various altitudes in the Andes of Ecuador, as well as in the thorn-bush and loma zones of the coast from the Santa Elena peninsula to southern Peru.

HABITATS. The type locality is the higher portion of Duncan Island, a ridge forming the east rim of the uppermost of two calderas. This ridge is densely populated by embiids. Lichen-covered bushes were observed to be entirely silk-covered, even to the extremities of twigs. An abandoned finch nest was laced with embiid galleries. Along the ridge cliffs lichen-encrusted rocks also were whitened by embiid silk. The vast colony may extend completely around the upper caldera. This was not confirmed, however, because of impenetrable vegetation. The embiid range appears to coincide with the almost perpetual mist zone beginning at about 1150–1200 feet in elevation on the island's north slope. The Duncan *Scalesia* occurs in this zone, epiphytic brown hepatica and a conspicuous orange lichen occur on the bushes. Bromeliads and orchids are found in this zone, mostly near the summit.

Embioptera were not encountered in the floor of the upper caldera, or on the vegetation and rocks around the lower caldera, the north rim of which attains about 1000 feet in elevation.

On Wenman (Wolf) Island another extensive colony covers lichen-encrusted rocks of the steep, crumbling cliffs of the upper ridge of the north side of the island's summit. Mr. Cavagnaro believes that this colony extends along both the east and west cliffs of the upper plateau, especially the higher west cliff, which receives an abundance of mist-laden breezes. Surprisingly, no embiid galleries were on the bushes, as on Duncan Island, all being confined to rock surfaces and crevices. Protected rock faces seemed to be preferred habitats. Sea birds, such as the red-footed booby, *Sula sula*, nest throughout the embiid zone, usually on small bushes just above the ground. Another bird, the swallow-tailed gull, *Gregarus furcatus*, is a ground nester whose nesting on Wenman mostly is restricted to the embiid zone.

On Culpepper (Darwin) Island, 20 miles from Wenman, no embiids were found. The island does not exceed 500 feet in elevation and, although there are lichens on its cliffs, it may be too low to support the species during extremely dry years of climatic cycles.

On Santa Cruz (Indefatigable) Island embiids were found exclusively in lichens and bark flakes of large bushes and trees, *Bursera* and *Cordia*, in a very open dry zone which receives but little fog moisture. Most of the speci-

mens were collected on the east slope below Table Mountain at about 150 meters elevation. Strangely, the more misty lichen zones of Santa Cruz, which appeared to be ecologically identical to comparable zones of Duncan and Wenman islands, seem to lack embiids. The coastal zones of Santa Cruz, although having lichens on rocks and trees, appear to be too dry for embiids.

**BIOLOGY.** The habits of *Chelicerca galapagensis* are basically similar to those of most embiids. The insects ramify the habitats with silk galleries and seek refuge from predators and periods of adverse climate in crevices. *Chelicerca galapagensis*, however, seems to be more sluggish and secretive than most embiids and specimens can only be collected by laboriously searching each tight curl of the lichens which also must constitute the principal food. Numerous other small arthropods share the habitat, especially a common spider which appears to be the most important predator of the embiids. When received, all cultures were heavily infested with sporozoan endoparasites, probably a species of *Diplocystis*, and, as a result, it was impossible to establish thriving laboratory cultures of the embiids.

The best indicator of life history cycles in embiids is the maturity period of males, the females being long-lived and overlapping generations. Adult males of *C. galapagensis* were present in the field, or in cultures, during every month of observation between February and July. The largest number occurred during June, however, and this is regarded as the life cycle peak with a maximum of mating activity of virgin adults. Mating probably occurs within the area of development and the eggs are laid here and there in the galleries rather than in clusters. It is doubtful whether more than one generation occurs per year.